ered, he regards the demand for an almost diametrically opposed type of presentation as justified. None the less, he is grateful for the availability of so admirable a text, written under so different an inspiration. The student with a fair foothold on the subject will here find the means of strengthening his grasp upon the problems arising specifically from the experimental issues.

JOSEPH JASTROW

LOUIS AGGASIZ'S LATER VIEWS ON THE CLASSIFICATION OF FISHES

WRITERS on ichthyology have expressed two distinct views concerning Louis Agassiz's work on the fishes. On the one hand, they have praised his contributions to descriptive ichthyology and his masterly work on the fossil forms; on the other, they have condemned his classification—declaring that a system which rests solely upon differences in scales is superficial and unphilosophical, and, even for his day, was a step backward, rather than forward.

But in thus condemning Louis Agassiz's views an injustice is done him, for he is credited only with the classification he elaborated early in life (in his "Poissons Fossiles," 1833–1844), but later abandoned and, in fact, repudiated. No cognizance is taken of his maturer views expressed many years later, at a time when he had ceased to contribute in any marked degree to the descriptive side of his science. One reason for this neglect of his later views is the fact that they were not elaborated in detail, but presented in bare outline before various societies; and are scattered in a dozen or two paragraphs through the proceedings of these societies. It is worth while, it seems to the writer, to bring together these later views of Agassiz and to indicate the steps by which he arrived at them.

As is well known, Louis Agassiz's larger works on the fishes were published in Europe. After coming to America he occupied himself chiefly with the invertebrates. None the less he never lost sight of his favorite group and continued his observations in it whenever opportunity offered. But he worked at so many subjects and with such haste that he never found time to elaborate all these observations. Except for three or four short papers[1] in which results were presented in more or less detail, his views on the fishes were set forth briefly. In the Proceedings of the American Academy of Arts and Sciences, and of the Boston Society of Natural History, during the fifties and sixties, are scattered numerous condensed records of his observations, some of great interest.

His earliest allusion to his first classification is found in a communication which he made in 1850[2] to the American Academy of Arts and Sciences, on the scales of the bonito. He showed that these scales are intermediate between the *ctenoid* and the *cycloid* types, the serrations being marginal only and not traversing the whole posterior portion of the scale.

In 1857[3] he announced that he had given up the classification of fishes by their scales and proposed a new classification which he said was founded upon embryological characters—although he did not specify what these characters were. He divided the fishes into four *classes:* (1) Selachians, (2) ganoids, (3) fishes proper, (4) myzonts [= cyclostomes].

This system, if we allow for the changes wrought since Agassiz's day in the group of the ganoids, is not much different from our modern ones. In ranking his groups as classes he was ahead of his time. There is a tendency at the present day to make the Cyclostomes and the Selachians, classes,[4] equivalent in rank to the class Pisces proper. Such a view, for instance, has recently been urged by Gill and, as far as the Selachians alone are

[1] A summary of these is given by Jordan in his "Agassiz on Recent Fishes," in the *American Naturalist*, XXXII., 1898, pp. 173–176.

[2] *Proceedings*, II., p. 238.

[3] *Proceedings Academy Arts and Sciences*, IV., pp. 8–9.

[4] It does not appear that Louis Agassiz used the word class with precisely the same connotation as given to it to-day. It was then used somewhat more loosely. However, this does not depreciate the value of his conclusion that these four groups are of equivalent rank.

concerned, also by Hubrecht and by Regan. Doubtless a similar view is held by other ichthyologists at the present time.

The arrangement of the fishes continued to exercise Agassiz during succeeding years. In 1858[5] he read a communication before the American Academy of Arts and Sciences advocating the classification of fishes by the structures of the mouth as related to the facial bones. And as late as 1867 he again occupied himself with fishes, reading, in that year,[6] a paper on the classification of the catfishes.

In the light of present knowledge this classification of the catfishes was not a happy one. He regarded the group as "an order of ganoid fishes which should be placed between the sturgeons and the garpikes." He based this view, he tells us, on resemblances in the brains of the catfish and the sturgeon; but he seems to have been unduly impressed by the South American armored catfishes. To be sure such forms as *Loricaria* and *Plecostomus* are in some regards suggestive of the sturgeon; but the resemblances are now looked upon as mere parallelisms and not as signs of relationship.

In conclusion: Louis Agassiz deserves greater credit for his later than for his earlier classification of the fishes. He sought to base it on facts of anatomy and embryology and not, as with the earlier classification, on a single superficial character. And in ranking the groups as classes and in raising the selachians, cyclostomes and fishes proper, to equivalent rank, he was the forerunner of our modern views.

L. Hussakof

THE SYNTHESIS OF FORMALDEHYDE BY LIGHT WITHOUT CHLOROPHYLL

Readers of Science will be interested in the achievement by chemists of the duplication of the first step in the synthesis of carbohydrates by plants. Many years ago it was found that formaldehyde, when made slightly alkaline, transformed itself spontaneously by a series of condensations into a mixture of sugars called "formose," but the first step in the process of the synthesis of the sugars, namely, the synthesis of formaldehyde from carbon dioxide and water with the liberation of oxygen it has been impossible to achieve under conditions at all comparable to those prevailing in plants. This synthesis has now been obtained by Berthelot and Gaudechon[1] by means of ultra-violet light.

A mixture of carbonic anhydride and water under the influence of these rays liberates oxygen and produces carbon monoxide and formaldehyde. Carbon monoxide and water so illuminated produce carbon dioxide, carbon monoxide, hydrogen and formaldehyde.

Moreover, glucose under similar conditions gives rise, among other things, to marsh gas, hydrogen and carbon dioxide.

It seems not impossible, in view of these facts, that the rôle of the chlorophyll may be the transformation of the longer wave-lengths of light to shorter more active ones, thus acting in a photodynamic way, as frequently suggested.

A. P. Mathews

SPECIAL ARTICLES

NOTE ON THE DISTRIBUTION OF SOME PENNSYLVANIA FISHES

While angling at Valley Forge, on September 27, 1910, I caught a number of small fishes in Valley Creek, a tributary of the Schuylkill River. As several of these have not been found before so far to the east in Pennsylvania, I take this opportunity of recording them. These are *Pimephales notatus* and *Exoglossum maxillingua*. Along sloping shores in shallow water were very numerous large schools of small fishes, which I found to be mainly the young of the preceding, though *Abramis crysoleucas, Notropis bifrenatus, N. cornutus, Fundulus diaphanus, Lepomis au-*

[5] *Proceedings Academy Arts and Sciences*, IV., p. 108.

[6] *Proceedings Boston Society Natural History*, XI., p. 354.

[1] "Synthése photochemique des hydrates de carbone aux dépens des elements de l'anhydre carbonique et de la vapeur de l'eau en l'absence de chlorophyll, etc.," *Comptes Rendus de l'Acad. de Sci.*, 150, 1910, p. 169.